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The Chemical Composition of Insecticides and Fungicides

By

R. H. Robinson and W. W. Yates

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INTRODUCTION

Before any spray material can be used successfully for the control of insect pests or fungous diseases it is necessary to know, first, what active constituents are present, and second, what amount or percentage of each active ingredient is present. This is especially important since the appearance on the market of many proprietary mixtures having the same active ingredients but in widely different amounts. For example, there are now for sale in the state more than fifty different brands of nicotine compounds that vary from 0.5 percent to 40.0 percent in the active ingredient, nicotine. Likewise, the different brands of sulfur, copper carbonate, dry bordeaux mixture, or any other commercial spray may vary in composition. There are also worthless materials that contain little if any fungicidal or insecticidal properties.

This publication reports the chemical analyses of various spray materials, collected in carrying out the provisions of the Oregon Economic Poison Law. As an aid in obtaining a better understanding of the spray ingredients, the quality and requirements of each kind are discussed briefly.

THE OREGON ECONOMIC POISON ACT

In order to prevent the sale of fraudulent materials and that the farmers may know more definitely regarding the composition of commercial spray materials, the Economic Poison Act was passed by the state legislature in 1923. The Chemist of the Agricultural Experiment Station has been appointed by the Director to supervise and carry out the provisions of the law. All correspondence pertaining to the law should be addressed to the Chemist, Oregon Experiment Station, Corvallis, Oregon.

The term "economic poison," patterned after the California usage, has been adopted to mean all materials that are poisonous to insects, fungi, or weeds regardless of whether they are poisonous to human beings or not.

The Economic Poison law provides "that any substance or mixture of substances intended to be used for preventing, destroying, repelling, or mitigating any and all insects, fungi, or weeds shall be registered at the office of the Director of the Oregon Experiment Station and a permit issued therefrom before the same can be offered for sale."

The law also provides that a plainly printed label must be attached to each original package of economic poison stating the following:

1. Name, brand, or trade-mark.
2. Name and percentage of each active ingredient.
3. Total inert ingredients.

4. Name and address of the manufacturer or person responsible for the sale of the material in Oregon.

Consumers should examine labels and report to the Chemist of the Experiment Station any omission, especially any pertaining to the active ingredients.

Dealers, salesmen, or other persons selling or offering for sale any economic poison are advised to ascertain from the Chemist of the Experiment Station whether or not the material has been registered by the manufacturer. If not, they must register their different brands on their own guarantee or request the manufacturer to register them before they handle them.

LIST OF REGISTERED MANUFACTURERS

During the past season the following manufacturers have registered their products and have been granted a permit for the calendar year 1925.

American Smelting and Refining Co.	444 Cal. St., San Francisco, California.
American Cyanamid Co.	Aysusa, California.
An-Fo Manufacturing Co.	3129 Elmwood Ave, Oakland, California.
Aphicide Spray Manufacturing Co.	Rocky Ford, Colorado.
Bowe, F. M.	724 E. Yamhill St., Portland, Oregon.
Braun-Knecht-Heimann Co.	San Francisco, California.
California Sprayer Co.	6001-11 Pasadena Ave., Los Angeles, Cal.
California Spray-Chemical Co.	Watsonville, California.
California Rex Spray Co.	Benicia, California.
Chipman Chemical Engineering Co.	136 Liberty St., New York City.
Danforth Chemical Co.	Leominster, Massachusetts.
Devoe and Raynolds	14 West Lake St., Chicago, Illinois.
Dow Chemical Co., The	Midland, Michigan.
Felton, T. A.	Harding and Loring St., Portland, Oregon.
General Chemical Co.	201 Sansome St., San Francisco, California.
Gideon Stolz Co.	Salem, Oregon.
Glidden Co., The	1300 7th St., San Francisco, California.
Grasselli Chemical Co., The	Cleveland, Ohio.
Hall Tobacco Chemical Co.	212 Fifth Ave., New York City.
Hammond Paint and Slug Shot Works	Beacon, New York.
Hardie Manufacturing Co., The	55 N. Front St., Portland, Oregon.
Hemingway Co., The	Shellmound and Horton St., Oakland, Cal.
Herbert and Herbert	P. O. Box 382, Perth Amboy, New Jersey.
Hood River Spray Co.	Hood River, Oregon.
Hooker Electrochemical Co.	25 Pine St., New York City.
J. and G. Orchard	Newberg, Oregon.
Latimer-Goodwin Chemical Co.	Grand Junction, Colorado.
Lee Co., George H.	Omaha, Nebraska.
LeGear Medicine Co., Dr. L. D.	4161 Beck Ave., St. Louis, Missouri.
Lehn and Fink	635 Greenwich St., New York City.
Leis, Mr. B.	Beaverton, Oregon.
Lilly Co., The Chas. H.	Seattle, Washington.
Lucas and Co., John	322 Race St., Philadelphia, Pennsylvania.
McClure Chemical Laboratories	Emeryville Station, Oakland, California.
Miller Products Co.	325 Railway Exchange Bldg., Portland, Ore.
Montgomery Ward and Co.	Portland, Oregon.
Mountain Copper Co.	332 Pine St., San Francisco, California.
Mt. Hood Spray Co.	Hood River, Oregon.
Mt. Hood Soap Co.	270 Glisan St., Portland Oregon.
Mulford Co., H. K.	Philadelphia, Pennsylvania.
National Chemical Co.	310 Sansome St., San Francisco, California.
Niagara Spray Co.	2598 Taylor St., San Francisco, California.
Nichols Copper Co.	25 Broad St., New York City.
North Coast Soap Co.	6307 17th Ave. S., Seattle, Washington.
Norvell Chemical Corporation, The	Perth Amboy, New Jersey.
Parke Davis and Co.	2951 Atwater St., Detroit, Michigan.
Pittsburg Plate Glass Co. Corona Chem. Div.	205 Lake St., Milwaukee, Wisconsin.
Roessler and Hasslacher Chem. Co.	709 Sixth Ave., New York City.
Sacramento Chemical Co.	1816 7th St., Sacramento, California.
San Francisco Sulfur Co.	624 California St., San Francisco, California
Sexton, Leonard	Freewater, Oregon.
Sherwin-Williams Co.	Emeryville, California.
Sunset Sales Co.	Tacoma, Washington.
Sutherlin Lime-Sulfur Manufacturing Plant	Sutherlin, Oregon.

Texas Gulf Sulfur Co.	41 E. 42d St., New York City.
Tobacco By-Products and Chemical Corp'n.	Louisville, Kentucky.
U. S. Smelting, Refining and Mining Co.	Salt Lake City, Utah.
Valley Fruit Co.	Walla Walla, Washington.
West Coast Clensel Distributing Co.	325 Cham. of Com. Bldg., Portland, Oregon.
Wheeler, Raynolds and Stauffer	624 California St., San Francisco, California.

If any brands of economic poison are offered for sale that have not been registered by one of the above manufacturers, the Chemist of the Experiment Station should be notified. Such materials should be considered questionable until the manufacturer registers and guarantees them.

Another important purpose of the law is to prevent the sale of those materials that have little or no value as an economic poison. As stated in Section 8 of the law, "the Director of the Experiment Station has power to refuse to register any material that has been shown to have little or no value for the purpose for which it is intended to be used." Thus far registration has been denied five worthless materials and their sale discontinued.

INSPECTION, COLLECTION, AND ANALYSIS OF SAMPLES

During the active spraying season representative samples of different brands of insecticides, fungicides, and weed killers are collected and analyzed. Those brands that show a lower percentage of active ingredients than is guaranteed by the manufacturer receive especial attention. The manufacturer is notified to change the guarantee or improve his product. If he fails repeatedly to do so or in any other way violates the provisions of the act, legal action is taken against him. Dealers, moreover, are requested not to handle the product, and publicity is given advising against its use.

During the year 1925 there were 302 different brands of economic poisons registered. Special attention is centered on certain classes of materials, especially those spray materials that are subject to chemical changes. New brands and new spray materials are promptly given especial attention. The Agricultural Chemistry department in cooperation with other departments of the Experiment Station will be pleased to give available information and advice regarding the composition and the use of this class of sprays.

ANALYTICAL REPORT OF SAMPLES

In the following pages are reported the guaranteed and found composition of economic poisons collected during the past season. Comments are also made relative to the chemical nature and stability of each material.

Lime-sulfur solution. Sulfur, chemically combined with calcium to form calcium polysulfide, is the principal active ingredient in lime-sulfur solution. For all practical purposes its concentration is indicated by the hydrometer test which, for commercial brands, should be at least 30° Baumé.

Lime-sulfur solution as locally prepared is subject perhaps to greater variation in composition than most sprays. When a poor grade of lime is used or the operator is careless in boiling the solution, the Baumé

reading may be low. The orchardist is advised to test the lime-sulfur solution with a Baumé hydrometer and make dilutions for spraying in accordance with Table II of Oregon Experiment Station Bulletin 201. If the test is below the Baumé guaranteed on the label it should be reported immediately to the Agricultural Chemistry department of the Experiment Station. A pint sample also should be sent with the report.

Although the total sulfur content would indicate approximately the strength of the lime-sulfur solution, the polysulfide sulfur and the Baumé reading are also given. The results are reported in Table I.

From the results in Table I it is apparent that some brands are below the guarantee. The deficiency, although small, should not be overlooked.

TABLE I. LIME-SULFUR SOLUTION

Name of manufacturer	Address	Guaranteed and found	Degree Baumé	Total sulfur	Calcium polysulfide
				%	%
Felton's, T. A., Portland, Or.		Guaranteed	30.0	-----	26.0
		Found	31.1	23.1	27.0
Gideon Stolz, Salem, Or.		Guaranteed	30.0	-----	27.3
		Found	30.3	23.3	27.6
J. and G. Orchard, Newberg, Or.		Guaranteed	30.0	22.0	-----
		Found	29.8	21.9	25.6
Hood River Spray Co., Hood River, Or.		Guaranteed	30.0	24.0	-----
		Found	30.7	22.9	26.9
Montgomery Ward & Co., Portland, Or.		Guaranteed	30.0	22.0	-----
		Found	29.4	22.0	25.4
Miller Products Co., Portland, Or.		Guaranteed	30.0	22.0	26.4
		Found	29.4	20.5	24.2
Sutherlin Lime Sulfur Manufacturing Plant, Sutherlin, Or.		Guaranteed	30.0	22.0	-----
		Found	29.6	21.7	26.6
Leis Lime-Sulfur, Beaverton, Or.		Guaranteed	30.0	22.0	-----
		Found	29.7	22.4	26.7
Valley Fruit Co., Walla Walla, Wash.		Guaranteed	30.0	-----	25.6
		Found	29.0	20.3	24.0

Dry lime-sulfur. There are several brands of dry lime-sulfur sold in Oregon. Although a powder, this is not a dusting spray but must be dissolved in water before it is applied. The dry lime-sulfur will give as effective results as the liquid lime-sulfur if used in equivalent amounts. This amount should be at the rate of 4.0 pounds of the dry material for each gallon of concentrated lime-sulfur required.

The different brands of the dry lime-sulfur vary somewhat in composition. They should contain a minimum of 65.0 percent of calcium polysulfide, the principal active ingredient, and not more than 15 percent free uncombined sulfur. Even a higher amount of calcium polysulfide is desirable. It is important, therefore, to note the guaranteed statement on the label and to examine the analytical report given in Table II.

Unless dry lime-sulfur is kept in nearly air-tight containers it may partly decompose, whereupon, due to the decreased polysulfide content of the oxidized material, its value as a dormant spray is greatly diminished.

The analysis given in Table II shows that most brands are below the guaranteed amount of the main active ingredient, calcium polysulfide. On the other hand, the free sulfur is higher than the guarantee. This combination decreases the value of the material as dormant spray although the excess free sulfur may be beneficial in summer sprays.

TABLE II. DRY LIME-SULFUR

Name of manufacturer	Address	Guaranteed and found	Calcium polysulfide	Calcium thiosulfate	Free sulfur
			%	%	%
Devoe & Raynolds,	Chicago, Ill.	Guaranteed	70.0	5.0	8.0
		Found	**64.4**	**7.5**	**11.8**
Hemingway's Co.,	Oakland, Cal.	Guaranteed	68.0	5.0	12.0
		Found	**61.9**	**4.9**	**14.1**
Montgomery Ward & Co.,	Portland, Or.	Guaranteed	60.0	8.0	12.0
		Found	**63.9**	**4.7**	**9.6**
John Lucas & Co.,	Philadelphia, Pa.	Guaranteed	70.0	5.0	10.0
		Found	**57.8**	**4.9**	**15.7**
Sherwin-Williams Co.,	Emeryville, Cal.	Guaranteed	68.0	5.0	12.0
		Found	**60.0**	**5.0**	**14.9**

Keeping qualities of dry lime-sulfur. Geo. P. Gray and Firman Thompson of the California department of Agriculture have investigated the conditions under which dry lime-sulfur may lose calcium polysulfide by decomposition. In Table II-a are reported some of their observations.

TABLE II-a. THE EFFECTS OF EXPOSURE TO AIR ON DRY LIME-SULFUR

	Sample A—Free exposure to air		Sample B—Four years old in pasteboard box		Sample C—Four years old in tight tin can	
	Original analysis	After one week	Guaranteed	Found	Guaranteed	Found
	%	%	%	%	%	%
Calcium polysulfide	62.44	29.40	60.0	**30.88**	63.00	**67.71**
Calcium thiosulfate	4.56	4.58	6.0	**10.50**	5.0	**5.17**
Sulfur	15.40	29.48	18.0	**28.07**	12.0	**9.59**

Quoting their conclusions: "These results clearly indicate that dry lime-sulfur undergoes a rapid deterioration when exposed to the air with a serious loss in calcium polysulfide, the most valuable ingredient. They also show that when packed in an air tight container it will keep indefinitely at its original strength and emphasize the necessity for consumers to insist that this product be packed properly. These statements should not be taken as meaning that dry lime sulfur decomposes more rapidly than lime sulfur solution kept under the same conditions, since this is probably not true."

Lead arsenate and calcium arsenate. Lead arsenate is a standardized product that does not vary greatly in composition. It can be relied upon generally to be in accordance with the guarantee. The analyses of the different brands as shown in Table III further confirm this statement.

There are a few brands of calcium arsenate offered on the Oregon market. On account of the unstableness of this arsenical it cannot be used safely as an orchard spray and consequently local demand for it is comparatively small. Calcium arsenate can be substituted advantageously for paris green for most purposes, especially in truck garden insect pest control. It costs less than paris green, contains 40 percent of the active ingredient arsenic oxide, and is less soluble.

TABLE III. LEAD ARSENATE

Name of manufacturer	Address	Guaranteed and found	Arsenic oxide Total	Arsenic oxide Water soluble	Lead oxide total
			%	%	%
Corona, Pittsburg Plate Glass Co.,	Milwaukee, Wis.	Guaranteed	30.0	.75	63.0
		Found	30.3	.18	66.0
Devoe and Raynolds Co.,	Chicago, Ill.	Guaranteed	30.0	.75	63.0
		Found	30.8	.38	63.3
Dow Chemical Co.,	Midland, Mich.	Guaranteed	30.0	.75	63.0
		Found	31.3	.29	63.5
General Chemical Co.,	San Francisco, Cal.	Guaranteed	30.0	.75	63.0
		Found	30.2	.18	63.3
Glidden Co.,	San Francisco, Cal.	Guaranteed	30.0	.75	63.0
		Found	31.3	.12	64.7
Grasselli Chemical Co.,	Cleveland, Ohio.	Guaranteed	30.0	.75	63.0
		Found	33.7	.18	63.3
John Lucas and Co.,	Philadelphia, Pa.	Guaranteed	30.0	.75	63.0
		Found	30.1	.11	61.6
Latimer Goodwin Chemical Co.,	Grand Junction, Colo.	Guaranteed	30.0	.75	63.0
		Found	31.0	.08	61.8
Montgomery Ward & Co.,	Portland, Or.	Guaranteed	31.0	.50	63.0
		Found	30.0	.07	66.0
Niagara Spray Co.,	San Francisco, Cal.	Guaranteed	30.0	.75	63.0
		Found	31.0	.04	64.3
Sherwin-Williams Co.,	Emeryville, Cal.	Guaranteed	30.0	.75	63.0
		Found	30.4	.15	63.9
The James Blanchard Co.,	New York, N. Y.	Guaranteed	Illegal, not registered.		
		Found	30.8	.23	66.9
	Calcium Arsenate				
Devoe and Raynolds,	New York, N. Y.	Guaranteed	40.0	.75	.....
		Found	40.7	.35	.....

Paris green. Although paris green has been superseded by calcium arsenate and lead arsenate it is still available on the Oregon market. It finds a place as an ingredient of insect baits that cannot be used as a foliage spray. It may contain as much as 3.5 percent water-soluble arsenic oxide, which due to danger of causing foliage burn, limits its use to hardy plants.

TABLE IV. PARIS GREEN

Name of manufacturer	Address	Guaranteed and found	Arsenious oxide	Copper
			%	%
Devoe and Raynolds,	Chicago, Ill.	Guaranteed	50.0	.....
		Found	52.5	22.5
Glidden Co.,	San Francisco, Cal.	Guaranteed	50.0	.....
		Found	51.7	25.7
Montgomery Ward & Co.,	Portland, Ore.	Guaranteed	50.0	.....
		Found	51.8	25.7
Sherwin-Williams,	Emeryville, Cal.	Guaranteed	50.0	.....
		Found	51.7	24.3
The Jas. Blanchard Co.,	New York, N. Y.	Guaranteed	Illegal, not regist'd	
		Found	52.4	22.1

Nicotine compounds and dusts. Especial care should be exercised in the purchase and subsequent handling of certain nicotine combinations. The dealer, also, who retails nicotine sprays should thoroughly understand the different combinations. This is important because some lose their nicotine content very rapidly, while others may be kept indefinitely without loss of the active ingredient.

Nicotine sulfate in liquid form is very stable and may be kept indefinitely without deterioration. The highest grade form is a solution of nearly 50 percent nicotine sulfate in water containing 40 percent nicotine. It is sold on the Oregon market as "Black Leaf 40," Hall's 40 percent nicotine, N. P. C. Nicotine, and Ortho nicotine sulfate. No other brands of this grade are available.

Nicotine dusts may or may not be stable compounds. The stability of the combination depends upon the carrier used to hold the nicotine. Their importance warrants the following detailed explanation:

In the preparation of nicotine dusts the use of some carrier or filler is necessary to hold the alkaloid and distribute it uniformly as a powder. Thatcher and Streeter of the New York Agricultural Experiment Station classify the carriers in three divisions:

First, "absorbent" carriers, which tend to prevent volatilization of the nicotine. This class of materials may be represented by talc, kaolin, and kieselguhr.

Second, "inert" carriers, which have no other effect than to distribute the nicotine so as to expose a larger surface for evaporation. This class may be represented by gypsum, sulfur, and slate dust.

Third, "active" carriers, which increase the volatility of the nicotine sulfate by changing it to a more volatile form. This class may be represented by hydrated lime, calcium carbonate (limestone), and magnesium carbonate.

Immediately after nicotine sulfate is mixed with one or more of the several carriers or fillers the probability of loss may be summarized as follows:

(1) With hydrated lime or calcium carbonate (limestone) significant losses will occur rapidly. Air-tight containers prevent this loss to a very limited extent only. Notable losses under these conditions have been observed, due perhaps, to chemical changes. In paper bags half or more of the nicotine may be lost in thirty days. In cartons practically all the nicotine would be lost in six months.

(2) When any of the absorbent or inert carriers are used together with either hydrated lime or calcium carbonate similar losses may be expected as noted under (1).

(3) With kaolin, talc, kieselguhr, sulfur, or similar carriers, no appreciable losses may be anticipated.

(4) Tobacco leaf or waste pulverized dust will not lose its nicotine unless hydrated lime is mixed with it.

From the above it is apparent that unless the carrier is known, any commercial nicotine dust should be used as soon as possible after it has been prepared. Dust held over from the previous season should be discarded or used in double amounts unless it is known that only "absorbent" or "inert" carrier was used in the mixture. It is not advisable to purchase nicotine dusts taken from broken packages.

Nicotine dusts may be home-prepared satisfactorily. Directions for the preparation of these dusts may be obtained by writing to the Chemistry department of the Experiment Station.

During the past season samples of the various nicotine compounds were collected. Only new stock samples were analyzed although several brands of old stock were inspected. No doubt the old stock would be

deficient in nicotine and the dealers were advised accordingly. The persons or firms having last year's goods were advised to handle only what could be disposed of during the active spraying season.

Tables V and VI contain the results of analyses. It will be observed that most of the brands came up to the guaranteed composition. One dust collected from an old stock lot showed only a part of the guaranteed nicotine content. This indicates loss of nicotine on storage of the previous year's stock. The importance, therefore, of using new stock is obvious.

TABLE V. NICOTINE COMPOUNDS

Brand	Name of manufacturer	Address	Guaranteed and found	Nicotine	
				%	
Nicotine sulfate	Hall Tobacco Chemical Co.	New York, N. Y.	Guaranteed	40.0	
			Found	40.3	
Black Leaf 40	Tobacco By-Products and Chemical Corp.	Louisville, Ky.	Guaranteed	40.0	
			Found	40.4	
Nico-Fume	Tobacco By-Products and Chemical Corp.	Louisville, Ky.	Guaranteed	40.0	
			Found	40.7	
Nico-Fume Paper	Tobacco By-Products and Chemical Corp.	Louisville, Ky.	Guaranteed	20.0	
			Found	30.3	
Tobacco Soap	Chas. H. Lilly Co.	Seattle, Wash.	Guaranteed	2.0	
			Found	2.3	Also Soap 6.0%
An-Fo	An-Fo Manufacturing Co.	Oakland, Cal.	Guaranteed	.8	Also Soap 12.5%
			Found	1.2	and Pine oil 1.5%

Miscellaneous dusts. In this classification are placed the powdered sulfurs, sulfur-lead arsenate, sulfur-hydrated lime, bordeaux-lead arsenate, and almost any other combination.

It is important to examine the label of these dusts in order to know how much of the active ingredients the dust is guaranteed to contain. Some of them may consist mainly of cheap, inert filler combined with enough of the active poison to permit its sale legally as an insecticide or fungicide. Table VII contains the analyses of a limited number of these samples.

Dry bordeaux mixture. The different brands of commercial bordeaux mixture are subject to considerable variation in the active ingredient copper. Nearly as important, however, is the physical condition of the material. Field experiments have shown that unless the powder is superfine it will not adhere sufficiently long to give control comparative with the home-prepared bordeaux mixture. Until a generally higher grade commercial product is available the consumer is advised to use home-prepared bordeaux mixture or add casein spreader to the commercial bordeaux to increase adherence.

TABLE VI. NICOTINE DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Nicotine	Sulfur	Arsenic oxide	Copper
				%	%	%	%
All-in-one	Niagara Sprayer Co.	San Francisco, Cal.	Guaranteed	1.25	65.0	2.85	.....
			Found	**1.47**	**61.0**	**3.35**	.....
Cali Spray No. 82	California Sprayer Co.	Los Angeles, Cal.	Guaranteed	2.50	.....	5.80	5.0
			Found	**3.38**	.....	**6.10**	**4.9**
Niagara No. 5	Niagara Sprayer Co.	San Francisco, Cal.	Guaranteed	1.75	58.0	.....	.....
			Found	**1.74**	**62.0**	.....	.....
Niagara No. 10	Niagara Sprayer Co.	San Francisco, Cal.	Guaranteed	3.25	40.0	.....	.....
			Found	**3.98**	**55.2**	.....	.....
Niagara No. 6	Niagara Sprayer Co.	San Francisco, Cal.	Guaranteed	2.00	.....	.....	.....
			Found	**3.83**	.....	.....	.....
Nico-Fume Powder	Tobacco By-Products and Chemical Corp.	Louisville, Ky.	Guaranteed	12.50	.....	.....	.....
			Found	**13.10**	.....	.....	.....
Fumigator	Hall Tobacco Chemical Co.	New York, N. Y.	Guaranteed	12.50	.....	.....	.....
			Found	**9.80**	.....	.....	.....
"Old Stock" Sample			Guaranteed	3.30	68.0	.....	.....
			Found	**.86**	**64.0**	.....	.....

TABLE VII. MISCELLANEOUS DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Active ingredients
D-6	Niagara Sprayer Co.	Middleport, N. Y.	Guaranteed	19.0% copper sulfate.
			Found	**18.8%** copper sulfate.
Copodust	Niagara Sprayer Co.	Middleport, N. Y.	Guaranteed	14.0% copper sulfate.
			Found	**12.0%** copper sulfate.
Vitedust	Niagara Sprayer Co.	Middleport, N. Y.	Guaranteed	11.0% copper sulfate and 14.0% lead arsenate.
			Found	**9.4%** copper sulfate and **12.8%** lead arsenate.
50-50	Niagara Sprayer Co.	Middleport, N. Y.	Guaranteed	48.0% lead arsenate.
			Found	**48.1%** lead arsenate.
85-15	Niagara Sprayer Co.	Middleport, N. Y.	Guaranteed	14.0% lead arsenate.
			Found	**16.6%** lead arsenate.
Bug Death	Danford Chemical Co.	San Francisco, Cal.	Guaranteed	5.0% lead oxide and 47.0% zinc oxide.
			Found	**7.0%** lead oxide and **38.8%** zinc oxide.
Bug Death Alfa	Danford Chemical Co.	San Francisco, Cal.	Guaranteed	1.0% lead oxide and 15.0% zinc oxide and 20.0% sulfur.
			Found	**5.7%** lead oxide and **30.3%** zinc oxide and **12.7%** sulfur.
Sure-Noxem	Devoe and Raynolds	Chicago, Ill.	Guaranteed	2.0% arsenous oxide and 6.0% sulfur.
			Found	**2.1%** arsenous oxide and **16.6%** sulfur.
Sulphur	San Francisco Sulphur Co.	San Francisco, Cal.	Guaranteed	100.0% sulfur.
			Found	**98.0%** sulfur.
Sulfo	Miller Products Co.	Portland, Ore.	Guaranteed	90.0% sulfur.
			Found	**86.0%** sulfur.

Table VIII shows that most of the dry bordeaux mixtures are in accord with the manufacturer's guarantee for the amount of the active ingredient copper.

TABLE VIII. DRY BORDEAUX MIXTURE

Name of manufacturer	Address	Guaranteed and found	Copper
			%
Corona, Pittsburg Plate Glass Co.	Milwaukee, Wis.	Guaranteed	18.9
		Found	-----
Devoe and Raynolds Co.	Chicago, Ill.	Guaranteed	11.0
		Found	12.7
Glidden Co.	San Francisco, Cal.	Guaranteed	15.0
		Found	16.5
John Lucas and Co.	Philadelphia, Pa.	Guaranteed	16.0
		Found	16.7
Hood River Spray Co.	Hood River, Or.	Guaranteed	*24.0
		Found	25.1
Miller Products Co.	Portland, Or.	Guaranteed	*24.0
		Found	22.1
Montgomery Ward and Company	Portland, Ore.	Guaranteed	*24.0
		Found	25.0
Rex Spray Co.	Toledo, Ohio	Guaranteed	Illegal, not registered
		Found	12.5
Sherwin-Williams Co.	Emeryville, Cal.	Guaranteed	12.7
		Found	12.6
James A. Blanchard Co.	New York, N. Y.	Guaranteed	Illegal, not registered
		Found	14.9

*These brands are the "two powder" bordeaux mixtures. One package contained partly dehydrated copper sulfate and the other hydrated lime and casein spreader. The copper is reported as found in one package.

Copper carbonate. Copper carbonate has been found very effective and less injurious than the older types of fungicides for bunt control in wheat. Similar to bordeaux mixture, the fineness of the dust particles is an important consideration. Most of the commercial brands have been improved to the extent that all particles pass through a 200-mesh sieve. This degree of fineness has been found satisfactory for effective adherence to the wheat seeds.

Our experiments, using 2 ounces of copper carbonate to the bushel of wheat, indicate that the minimum amount of copper present for most effective control should be 50.0 percent. Table IX shows that, with one exception, all brands contain a minimum of 50 percent copper.

TABLE IX. COPPER CARBONATE

Name of manufacturer	Address	Guaranteed and found	Copper
			%
Braun-Knecht-Heimann Co.	San Francisco, Cal.	Guaranteed	50.0
		Found	50.2
Corona, Pittsburg Plate Glass Co.	Milwaukee, Wis.	Guaranteed	18.0
		Found	19.1
Miller Products Co.	Portland, Or.	Guaranteed	54.0
		Found	53.5
Montgomery Ward & Co.	Portland, Or.	Guaranteed	54.0
		Found	54.0
Nichols Copper Co.	New York, N. Y.	Guaranteed	52.0
		Found	55.1
Roessler and Hasslacher Chemical Co.	New York, N. Y.	Guaranteed	53.0
		Found	49.3
Sherwin-Williams Co.	Emeryville, Cal.	Guaranteed	50.0
		Found	51.3
Wheeler, Raynolds and Stauffer	San Francisco, Cal.	Guaranteed	50.0
		Found	50.2
The Mountain Copper Co.	San Francisco, Cal.	Guaranteed	54.0
		Found	-----

Mercuric fungicides. Recently several organic mercury compounds have been developed that have proved effective as fungicides and insecticides. Their cost is an objection at present, but this difficulty may be overcome as cheaper methods of manufacture are developed.

Among these compounds may be listed demesan, seed-o-san, chlorophol, germisan, and uspulun.

Formaldehyde. Formaldehyde is another commonly used fungicide. The commercial product should contain 37.0 percent formaldehyde by weight. Table X shows the grade of products inspected.

TABLE X. FORMALDEHYDE

Name of manufacturer	Address	Guaranteed and found	Formaldehyde
			%
Roessler and Hasslacher Chemical Co.,	New York, N. Y.	Guaranteed	37.0
		Found	37.5
Braun-Knecht-Heimann Co.,	San Francisco, Cal.	Guaranteed	37.0
		Found	37.8

Miscible oils and soaps. Miscible oils and various oil emulsions are manufactured from kerosene and the heavier mineral oils. It is necessary that a good quality emulsion be produced in order that the oil may be dispersed uniformly throughout the diluted spray. If the oil separates out, injury to the tree may ensue.

Two types of emulsions are now available: one in which the oil is emulsified with soap and cresylic acid, and the other in which the oil is dispersed by means of a protein material such as casein or some other emulsifying agent. More trouble may be experienced with the latter type, and care should be taken to see that the oil does not separate out in the spray tank.

Various other ingredients are sometimes added depending upon the formula of the manufacturer. The oil content, however, is the main active ingredient and all of the emulsions examined contained more than the guaranteed amount.

Several brands of soap are offered on the market primarily as spray soaps. These are guaranteed to be either pure whale-oil or fish-oil products. There are also the "hard" and "soft" whale-oil soaps. The soft soaps are the potash soaps, while the hard types are soda soaps. It is well to examine the label and purchase the soap on the guaranteed actual weight of the dry soap.

Earwig baits. On account of the earwig infestation in various parts of Oregon there were offered for sale during the past season three brands of earwig poison baits. These brands are prepared in accordance with the formula recommended by the Entomology department of the Experiment Station, with sodium fluoride as the toxic ingredient. There should be a minimum of 4.0 percent sodium fluoride present. Table XI contains the results of analyses.

TABLE XI. EARWIG BAIT

Name of manufacturer	Address	Guaranteed and found	Sodium fluoride
			%
Hardie Manufacturing Co.,	Portland, Or.	Guaranteed	4.3
		Found	4.8
Miller Products Co.,	Portland, Or.	Guaranteed	4.3
		Found	4.7
City of Portland,	Portland, Or.	Guaranteed	4.3
		Found	4.9

Miscellaneous materials. Among the miscellaneous fungicides and insecticides may be itemized Hellebore, Entomocide, Naptho, Paradichlorobenzene, Maggotbait, Carco, Lee's Garden Insecticide, weed killers, and others. Table XII gives the composition of these miscellaneous materials.

TABLE XII. MISCELLANEOUS SPRAY MATERIALS

Brand	Name of manufacturer	Address	Guaranteed and found	Ingredients
Garden Insecticide	Geo. H. Lee,	Omaha, Neb.	Guaranteed	Nicotine, sodium floride, sulfur, napthalene, pyrethum.
			Found	Passed (small deficiency in sodium floride and sulfur).
Carco	Sunset Sales Co.,	Tacoma, Wash.	Guaranteed	Phenols, soap, hydrocarbons.
			Found	Passed.
Maggotbait	Chas. H. Lilly Co.,	Seattle, Wash.	Guaranteed	Anthracene oil .8%.
			Found	Anthracene oil 1.4%.
Naptho	Miller Products Co.,	Portland, Or.	Guaranteed	Napthalene 9.1%.
			Found	Napthalene 9.8%.
Paracide	Hooker Electro Chem. Co.,	New York, N. Y.	Guaranteed	Paradichlorobenzene 99%.
			Found	Passed.
USS Co. Weed Killer	U. S. Smelting and Mining Co.,	Salt Lake City, Utah	Guaranteed	Sodium arsenate 62.0%.
			Found	Sodium arsenate 65.0%.
Hellebore	Lehn and Fink,	New York, N. Y.	Guaranteed	Alkaloids of powdered plant.
			Found	Passed.
Clensel	West Coast Clensel Distributing Co.,	Portland, Or.	Guaranteed	Ammonia, essential oil, soap.
			Found	Passed.
Entomocide	Sacramento Chem. Co.,	Sacramento, Cal.	Guaranteed	Phenol, carbon tetrachloride, oil of citronella, mineral oil.
			Found	Passed.

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